

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Currently Amended) An end effector adapted to grip a peripheral edge of a workpiece, comprising:

a workpiece blade for supporting a workpiece;

a first gripper arm operatively mounted to said workpiece blade, said first gripper arm including a first contact pad and first load sensing device for generating electrical signals representing the amount of force said first contact pad is exerting on the workpiece;

a second gripper arm operatively mounted to said workpiece blade, said second gripper arm having a second contact pad and a second load sensing device for generating electrical signals representing the amount of force said second contact pad is exerting on the workpiece, wherein said first gripper arm and said second gripper arm each include a proximal end and a distal end, said proximal end of said first gripper arm and said second gripper arm are each rotatably connected to a proximal end of said workpiece blade;

a motor assembly for moving said first and second gripper arms between a workpiece-loading position and a workpiece-engaging position; and

a processor for receiving said electrical signals from said first load sensing device and said second load sensing device and controlling the drive current supplied to said

motor assembly, enabling said processor to continually adjust the force said first contact pad and said second contact pad exerts on the workpiece.

2. (Cancelled)
3. (Cancelled)
4. (previously presented) The end effector according to claim 1, wherein said first and second contact pads further include sensors adapted to detect the edge of the workpiece.
5. (Original) The end effector according to claim 4, wherein said sensors comprise thru-beam sensors.
6. (Cancelled)
7. (currently amended) An end effector adapted to grip a peripheral edge of a workpiece, comprising:
 - a workpiece blade for supporting a workpiece;
 - a first gripper arm and a second gripper arm each operatively mounted to said workpiece blade, said first and second gripper arms each including a contact pad;
 - a motor assembly for moving said first and second gripper arms between a workpiece-loading position and a workpiece-engaging position, said contact pads contacting the peripheral edge of the workpiece and exerting a force on the workpiece when said first and second gripper arms are located in said workpiece-engaging position, said motor assembly including:
 - a motor having an output shaft;

a cam coupled to said output shaft, said cam having a geometrical center that is offset from a ~~[[the]]~~ rotational center of said output shaft;

a carriage having a drive slot adapted to receive said cam; and

a real-time force feedback system for generating an electrical signal representing the amount of force said contact pads exert on the peripheral edge of the wafer and controlling said electrical signal supplied to said motor assembly for dynamically adjusting the force exerted by said contact pads on the workpiece while said first and second gripper arms are located in said workpiece-engaging position.

8. (previously presented) The end effector according to claim 7, wherein said real-time force feedback system comprises:

a force sensing device coupled to each one of said contact pads, each force sensing device adapted to generate an electrical signal representing the amount of force said contact pad exerts against the workpiece; and

a processor for receiving said electrical signal from each said force sensing device and controlling the drive current supplied to said motor so that said motor may adjust the position of said first and second gripper arms.

9-16. (Previously Cancelled)

17. (Currently Amended) An apparatus for handling wafers, comprising:

a wafer blade for supporting a wafer;

a first contact arm and a second contact arm each operatively mounted to said wafer blade, said first and second contact arms each having a contact pad adapted to contact

a peripheral edge of the wafer, wherein said first contact arm and said second contact arm each include a proximal end and a distal end, said proximal end of said first contact arm and said second contact arm are each rotatably connected to a proximal end of said wafer blade;

a motor assembly operatively connected to said first and second contact arms, said motor assembly for moving said first and second contact arms between a wafer-loading position that allows a wafer to be loaded onto said wafer blade and a wafer-engaging position where each said contact pad contacts the peripheral edge of the wafer;

a force sensing device coupled to each one of said contact pads, each force sensing device adapted to generate electrical signals representing the amount of force said contact pad is exerting against the peripheral edge of the workpiece; and

a processor for receiving said electrical signals from each said force sensing device and controlling the drive current supplied to said motor assembly such that said processor maintains said electrical signals received from said force sensing devices at a substantially constant level.

18. (previously presented) The apparatus according to claim 17, wherein each said force sensing device measures the force said contact pad exerts on the wafer in real-time.

19. (Previously Presented) The apparatus according to claim 17, wherein each said contact pad further includes a sensor adapted to detect the edge of the wafer.

20. (previously presented) The apparatus according to claim 17, wherein each said force sensing device comprises a load cell.

21. (Original) The apparatus according to claim 17, wherein said force sensing device comprises a strain gauge.

22-35. (Cancelled)

36. (previously presented) The end effector according to claim 1, wherein said first and second load sensing devices comprises a load cell.

37. (previously presented) The end effector according to claim 1, wherein said first and second load sensing devices comprises a strain gauge.

38. (currently amended) The end effector according to claim 1, wherein said workpiece blade includes ~~a proximal end and~~ a distal end.

39. (cancelled).

40. (previously presented) The end effector according to claim 38, wherein said distal end of said workpiece blade comprises a first finger and a second finger.

41. (previously presented) The end effector according to claim 40, wherein said first finger and said second finger each include a workpiece support pad.

42. (new) The end effector of claim 1, wherein the processor controls the drive current supplied to said motor assembly in real time and wherein said motor assembly includes,

a cam coupled to said output shaft, said cam having a geometrical center that is offset from a rotational center of an output shaft; and

a carriage having a drive slot adapted to receive said cam.

43. (new) The apparatus of claim 17, wherein the processor controls the drive current

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supplied to said motor assembly in real time and wherein said motor assembly includes,

a cam coupled to an output shaft, said cam having a geometrical center that is offset from a rotational center of said output shaft; and

a carriage having a drive slot adapted to receive said cam.